

IN THE SPECIFICATION:

Replace the title with the following:

POLARIZATION CONVERSION ELEMENT, POLARIZATION
ILLUMINATOR, DISPLAY USING THE SAME ILLUMINATOR, AND
[PROJECTION TYPE DISPLAY] PROJECTOR

Replace the paragraph beginning at column 1 line 9 with the following:

The present invention relates to a polarizing conversion device and a polarizing illumination device for generating, from incident light beams as randomly polarized beams, illuminating beams that have a more uniform light intensity distribution in an illumination region than that of the incident beams and are polarized in almost the same direction. Furthermore, the present invention relates to a display apparatus and a [projection display apparatus] projector using these devices.

Replace the paragraph beginning at column 6 line 58 with the following:

A [projection display apparatus] projector in accordance with the present invention comprises a light source, a first optical element for separating a light beam emitted from the light source into a plurality of intermediate beams, a second optical element disposed near the position where the intermediate beams converge, a modulating device for modulating a light beam emitted from the second optical element, and a projection optical system for projecting the light beam modulated by the modulating device onto a projection plane, wherein the second optical element has a condenser lens array that includes a plurality of condenser lenses for respectively condensing the intermediate beams, a polarizing separation element for spatially separating each of the

intermediate beams into an S polarized beam and a P polarized beam, a selective phase plate for aligning the polarization direction of one of the S and P polarized beams separated by the polarizing separation element with the polarization direction of the other polarized beam, and a superimposing lens for superimposing the polarized beams, the polarizing separation element has a polarizing separation plane for separating the P and S polarized beams by transmitting one of the polarized beams therethrough and reflecting the other polarized beam and a reflecting plane located almost in parallel with the polarizing separation plane to reflect the polarized beam reflected by the polarizing separation plane toward the emergent direction of the polarized beam transmitted through the polarizing separation plane, and at least one of a shading means and an optical attenuating means for preventing each of the intermediate beams from directly entering the reflecting plane is interposed between the first optical element and the polarizing separation element.

Replace the paragraph beginning at column 7 line 22 with the following:

By adopting the above structure, the [projection display apparatus] projector of the present invention can effectively prevent a phenomenon in which other polarized beams polarized in a different direction mix into polarized beams of almost the same type polarized in the same direction. Therefore, when a polarizing plate is used to obtain a required polarized beam to be modulated by the modulating device, it is possible to prevent the increase in temperature of the polarizing plate caused by absorption of an unnecessary polarized beam, and to substantially simplify and reduce the size of a cooling device for cooling the polarizing plate. A liquid crystal device may be used as the modulating device.

Replace the paragraph beginning at column 7 line 44 with the following:

The [projection display apparatus] projector further comprises a color light separation means for separating the light beam emitted from the second optical element into a plurality of colored lights, a plurality of modulating devices for respectively modulating the colored lights, and a colored light synthesizing means for synthesizing the colored lights modulated by the modulating devices, wherein a synthesized beam synthesized by the colored light synthesizing means is projected onto the projection plane through the projection optical system. Since exclusive modulating devices can be placed respectively for more than two separated colored lights, it is possible to achieve a compact [projection display apparatus] projector capable of projecting and displaying a color image that is bright and has a high color reproducibility and a high resolution.

Replace the paragraph beginning at column 7 line 59 with the following:

In the above [projection display apparatus,] projector, the modulating device may be formed of a reflection-type liquid crystal device. In general, the reflection-type liquid crystal device provides the advantage of easily obtaining a relatively high aperture ratio even if pixel density is increased. Therefore, adopting of the above structure makes it possible to achieve a compact [projection display apparatus] projector capable of projecting and displaying a color image that is bright and has a high color reproducibility and a high resolution.

Replace the paragraph beginning at column 8 line 38 with the following:

FIG. 12 is a schematic structural view showing the principal part of an optical system in a [projection display apparatus] projector according to a third embodiment of

the present invention, in which the polarizing illumination device shown in FIG. 1 is incorporated.

Replace the paragraph beginning at column 8 line 43 with the following:

FIG. 13 is a schematic structural view showing the principal part of an optical system in a [projection display apparatus] projector according to a fourth embodiment of the present invention, in which the polarizing illumination device shown in FIG. 1 is incorporated

Replace the paragraph beginning at column 8 line 48 with the following:

FIG. 14 is a schematic structural view showing the principal part of an optical system in a modification of the [projection display apparatus] projector according to the fourth embodiment of the present invention, in which the polarizing illumination device shown in FIG. 1 is incorporated.

Replace the paragraph beginning at column 18 line 8 with the following:

A description will be given of a first example of a [projection display apparatus] projector in which the polarizing illumination device 1 described in the first embodiment is incorporated. In this embodiment, a transmission-type liquid crystal device is used as a modulating device for modulating light beams emitted from the polarizing illumination device according to display information.

Replace the paragraph beginning at column 18 line 15 with the following:

FIG. 12 is a schematic structural view showing the principal part of an optical system of a [projection display apparatus] projector 3 according to this embodiment, and

shows the sectional structure in the XZ plane. The [projection display apparatus] projector 3 of this embodiment generally comprises the polarizing illumination device 1 described in the first embodiment, a colored light separating means for separating a white light beam into three colored lights, three transmission-type liquid crystal devices for modulating the colored lights according to display information and thereby forming display images, a colored light synthesizing means for forming a color image by synthesizing the three colored lights, and a projection optical system for projecting and displaying the color image.

Replace the paragraph beginning at column 19 line 1 with the following:

The [projection display apparatus] projector 3 having such a structure employs the liquid crystal devices each for modulating one type of polarized beam. Therefore, if randomly polarized beams are directed to the liquid crystal device by using a conventional illumination device, about half of them are absorbed by a polarizing plate (not shown) and turned into heat. Therefore, the light use efficiency is low, and there is a need for a large and noisy cooling device for minimizing heat generation of the polarizing plate. The [projection display apparatus] projector 3 of this embodiment, however, substantially improves such problems.

Replace the paragraph beginning at column 19 line 12 with the following:

In the polarizing illumination device 1 of the [projection display apparatus] projector 3 according to this embodiment, only one type of polarized beam, for example, a P polarized beam is subjected to the rotatory polarization action by a $\lambda/2$ phase plate, and the polarization direction thereof is made identical with that of the other type of polarized beam, for example, an S polarized beam. Since substantially the same type of

polarized beams, which are polarized in the same direction, are directed to the liquid crystal devices 411, 412, and 413 located at three positions, the amount of light to be absorbed by the polarizing plate is extremely small, which makes it possible to enhance the light use efficiency, and to thereby obtain a bright projection image.

Replace the paragraph beginning at column 19 line 25 with the following:

Particularly, in the polarizing illumination device 1 used as an illumination device, since the shading plate 370 is placed inside the second optical element 300, other polarized beams which are unnecessary for display on the liquid crystal device rarely mix into the illumination light emitted from the polarizing illumination device 1. As a result, the amount of light absorbed by polarizing plates (not shown) respectively placed on the light incident sides of the liquid crystal devices 411, 412; and 413 located at three positions is extremely small, and therefore, the amount of heat generated in light absorption is extremely small. Consequently, it is possible to substantially reduce the size of a cooling device for minimizing the increase in temperature of the polarizing plates and the liquid crystal devices. As mentioned above, a small cooling device will do for a [projection display apparatus] projector capable of displaying a considerably bright projection image with a considerably high-power light source lamp, which makes it possible to reduce noise of the cooling device, and to thereby achieve a quiet and high-performance [projection display apparatus] projector.

Replace the paragraph beginning at column 19 line 51 with the following:

As described in connection with the above described first embodiment, the widening of light beams emitted from the polarizing separation unit array 320 is restricted although the polarizing illumination device 1 of this embodiment incorporates

polarizing conversion optical elements therein. This means that minimal light enters the liquid crystal device at a large angle in illuminating the liquid crystal device. Accordingly, it is possible to achieve a bright projection image without using a projection lens system having a small F-number and an extremely large aperture, and to thereby achieve a compact [projection display apparatus.]projector.

Replace the paragraph beginning at column 20 line 10 with the following:

The [projection display apparatus] projector may comprise a mirror optical system using two dichroic mirrors as the colored light synthesizing means. Of course, it is also possible in that case to incorporate the polarizing illumination device of this embodiment, and to form a high-quality bright projection image having a high light use efficiency, similarly to this embodiment.

Replace the paragraph beginning at column 20 line 19 with the following:

Another embodiment of a [projection display apparatus] projector in which the polarizing illumination device 1 described in the first embodiment is incorporated will be described. In this embodiment, reflection-type liquid crystal devices are used as modulating devices for modulating light beams emitted from the polarizing illumination device according to display information.

Replace the paragraph beginning at column 20 line 26 with the following:

FIG. 13 is a schematic structural plan view of the principal part of an optical system in a [projection display apparatus] projector 4 of this embodiment. The [projection display apparatus] projector 4 of this embodiment generally comprises the polarizing illumination device 1 of the first embodiment, a polarizing beam splitter 480,

a crossed dichroic prism 450 doubling as the colored light separation means and the colored light synthesizing means, three reflection-type liquid crystal devices 414, 415, and 416 serving as modulating devices, and a projection lens 460 serving as the projection optical system.

Replace the paragraph beginning at column 21 line 26 with the following:

The [projection display apparatus] projector 4 having such a structure also employs liquid crystal devices that each modulate one type of polarized beam, similarly to the above described [projection display apparatus] projector 3. Therefore, when a conventional illumination device for using randomly polarized beams as illumination light is employed, light beams separated by the polarizing beam splitter 480 and directed to the reflection-type liquid crystal devices are reduced to approximately half the number of the randomly polarized beams, the light use efficiency is low and a bright projection image is difficult to obtain. In the [projection display apparatus] projector 4 of this embodiment, however, such a problem is substantially improved.

Replace the paragraph beginning at column 21 line 39 with the following:

That is, the [projection display apparatus] projector 4 of this embodiment can efficiently generate substantially the same type of polarized beams, that are polarized in the same direction, by using the polarizing illumination device 1 of the present invention instead of the conventional illumination device, and therefore, almost all light beams that are incident on the polarizing beam splitter 480 are directed as illumination light beams to the reflection-type liquid crystal devices 414, 415, and 416 located at three positions. As a result, it is possible to obtain a bright projection image that is uniform in brightness and color.

Replace the paragraph beginning at column 21 line 66 with the following:

As described in connection with the above described first embodiment, the widening of light beams emitted from the polarizing separation unit array 320 is restricted although the polarizing illumination device 1 of this embodiment incorporates polarizing conversion optical elements therein. This means that minimal light enters the liquid crystal device at a large angle in illuminating the liquid crystal device. Accordingly, it is possible to achieve a bright projection image without using a projection lens system having a small F-number and an extremely large aperture, and to thereby achieve a compact [projection display apparatus.] projector.

Replace the paragraph beginning at column 22 line 10 with the following:

Condenser lenses 417 may be respectively interposed between the crossed dichroic prism 450 and the liquid crystal devices 414, 415, and 416 located at three positions in the [projection display apparatus] projector 4 of this embodiment. FIG. 14 shows a schematic structure of an optical system in that situation. Since such placement of these condenser lenses allows illumination light beams from the polarizing illumination device 1 to be directed to the liquid crystal devices while restricting the widening of the light beams, it is possible to further improve the efficiency in illuminating the liquid crystal devices, and the incident efficiency in making light beams reflected by the liquid crystal devices enter the projection lens 460. From the viewpoint of reduction of light losses at the lens interfaces, it is preferable to place each condenser lens integrally with the liquid crystal device as shown in FIG. 14, or with the crossed dichroic prism.

Replace the paragraph beginning at column 22 line 27 with the following:

Although S polarized beams are used as illumination light in the [projection display apparatus] projector 4 of this embodiment, P polarized beams may be used as illumination light. In this case, the polarizing illumination device 1 and the crossed dichroic prism 450 are placed opposed to each other through the polarizing beam splitter 480.

Replace the paragraph beginning at column 22 line 33 with the following:

Furthermore, though the crossed dichroic prism is used as the colored light separation means and the colored light synthesizing means in this embodiment, the [projection display apparatus] projector may comprise two dichroic mirrors instead. Of course, it is also possible in that case to incorporate the polarizing illumination device of this embodiment, and to form a high-quality bright projection image having a high light use efficiency, similarly to this embodiment.

Replace the paragraph beginning at column 22 line 41 with the following:

As described above, according to the present invention, it is possible to achieve a polarizing conversion device and a polarizing illumination device capable of generating with high efficiency only the same type of polarized beams that have a more uniform light intensity distribution in a illumination region than incident light beams, and, at the same, that are polarized in the same direction. Furthermore, it is possible to easily achieve a display apparatus and a [projection display apparatus] projector capable of displaying a high-quality bright image through the use of the polarizing conversion device and the polarizing illumination device of the present invention.